R E P O R T R E S U M E S

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RESOURCE ALLOCATION PROCESSOR FOR THE SCHOOL SIMULATION VEHICLE PILOT VERSION.

BY- YETT, FRANK A.
SYSTEM DEVELOPMENT CORP., SANTA MONICA, CALIF.

REPORT NUMBER NDEA-VIIA-1130-21 PUB DATE 23 JAN 64
REPORT NUMBER BR-5-0738-21
REPORT NUMBER TM-1493/300/00
GRANT OEG-7-14-9120-217
EDRS PRICE MF-$0.09 HC-$1.24 31P.

DESCRIPTORS- *SIMULATION, *COMPUTER PROGRAMS, *MODELS, *SYSTEMS ANALYSIS, EDUCATIONAL PLANNING, *SCHOOL ORGANIZATION, PILOT PROJECTS, SANTA MONICA, CALIFORNIA, CONTINUOUS PROGRESS PLAN SCHOOLS

A DESCRIPTION WAS PRESENTED OF A SIMULATION VEHICLE THAT WAS BEING DEVELOPED TO PERMIT MODELING ANY SCHOOL CONFIGUATION. THE MODEL WAS CONSIDERED AS HAVING TWO MAJOR PARTS--(1) THE ACTIVITY PROCESSOR AND (2) THE RESOURCE ALLOCATION PROCESSOR. THE ADDITION OF THE RESOURCE ALLOCATION PROCESSOR TO THE PREVIOUSLY DEVELOPED SIMULATION VEHICLE PROVIDES FOR (1) THE LOGICAL FLOW AND (2) THE THE CAPABILITY FOR CONTROL OF RESOURCES (PERSONS, PLACES, AND THINGS) BY ANALYZING THE TERMINATION, CONTINUATION, AND ACTIVATION OF ACTIVITIES ACCORDING TO THE LOGICAL DEMANDS OF THE SIMULATION VEHICLE AND THE CURRENT EXPRESSION OF THE SYSTEMS RESOURCE CAPABILITIES. FLOWCHARTS OF THE RESOURCE ALLOCATION PROCESSOR ARE INCLUDED. RELATED REPORTS ARE ED 010 559 AND ED 010 577 THROUGH ED 010 581. (AL)

VII A-1130
(S-0738)

The research reported herein was conducted under SDC's independent research program and Grant 7-14-9120-217, U. S. Department of Health, Education, and Welfare, Office of Education.

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ED010578

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TECH MEMO

a working paper

System Development Corporation / 2500 Colorado Ave. / Santa Monica, California

TM-1493/300/00

AUTHOR F.A.Y. Frank A. Yett

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RELEASE DBR David G. Ryans

for Director of Research

DATE 1-23-64 PAGE 1 OF 23 PAGES

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Resource Allocation Processor for the School Simulation Vehicle Pilot Version

by

Frank A. Yett

TM-1409, "Construction of a Simulation Vehicle" (6 August 1963), describes a general vehicle that will permit modeling any school configuration. The vehicle including charts and verbal descriptions, shows the logical flow and control of activities which faculty, staff and students perform. The vehicle described in TM-1409 does not include the control of resource or time. Computer programs using this description are called the Pilot Version Mod 1 and that part of the model included in Mod 1 is called the Activity Processor.

The description of the simulation vehicle in the present document includes considerations of time and resource control. The simulation vehicle is here considered as a model with two major parts: the Activity Processor and the Resource Allocation Processor. As yet, it does not include an "Information Processor," to formally effect control of data input and output, format, analysis, and processing. At present, the necessities of data processing and record keeping are included ad hoc in the computer versions of the model.

Resource Allocation Processor

Addition of the Resource Allocation Processor to the simulation vehicle provides the logical flow and the capability for control of resources (persons, places and things) with appropriate regard to timing. It analyzes termination, continuation and activation of activities according to the logical demands of the simulation vehicle and the current expression of the system's resource capabilities. It is described in Figures 1-3 in the Appendix.

Timing

Time duration in the simulation vehicle is expressed on two time scales. The one for the Activity Processor is a series of time units, logically connected end to end, ad infinitum. All activities begin at the start of a time unit and terminate at the end of a time unit. From its beginning to its end, an activity is said to be underway. During the time in which the activity is being performed, the resources engaged by the activity undergo no change. All change in resources takes place at the completion of the activity.

The Resource Allocation Processor operates on a time scale considered as a series of "suspended" or "null" periods interspersed between successive time units of the Activity Processor. During each such null period the model is reconstituted so that all completed activities are deleted from the Activity Processor. Since the logical expression of the simulator requires a next activity for each student who has been released from a terminated activity, new next activities are made ready, as necessary, for possible activation in the next time unit of the Activity Processor. If the next activity for a released student requires only one student, that next activity is made ready by the Resource Allocation Processor. If the next activity requires more than one student, such a next activity is made ready unless an appropriate next activity which has previously been made ready can accommodate additional students in queue.

Logical and Physical Presence

In the view of the simulator, each activity taking place requires the "presence" of a student in queue. Since many activities in the system are done for or because of the student, rather than with or by the student, the "presence" of a student can be either a logical state or a physical state. In a logical state, the activity is appropriate as an expression of service to the student. In a physical state, the student must physically participate as part of the system.

This presence of the student in an activity, being either logical or physical, has no bearing on the state of presence required of him by the next activity. Either state of presence in one activity may be followed, through application of the distribution rules imposed, by either a logical or physical state in the queue of a next activity.

Classification of Activities and Activity Processor Lists

The Activity Processor includes all the activities necessary to express the simulation during any time unit, i. These activities represent a subset of all possible activities which the simulation vehicle implies by reason of its logical expression.

All the activities in the Activity Processor during any time unit, i, are considered to be on the:

Active List, all those activities underway during time unit i

or the

Dormant List, made up of all those activities which have been made ready by the Resource Allocation Processor prior to the beginning of time unit i, but which are not underway, including:

1) Activities requiring only one student, with one student in queue,

   a) As required (logically or physically), but without sufficient resources otherwise.

   b) Logically present, but physically required, with or without sufficient resources otherwise.

2) Activities requiring more than one student.

   a) With one or more students in queue, but with insufficient number of students in queue, with or without sufficient resources otherwise.

   b) With a sufficient number of students in queue.

      1) Some of which are logically present but physically required, with or without sufficient resources otherwise.

      2) All of which are present as required (logically or physically) without sufficient resources otherwise.

Any activity requiring the logical presence of only one student can always be placed underway if the system's resource capability is adequate and criteria governing priority of execution are otherwise satisfied.

Mod 2 and Mod 3 of the Pilot Version

The first combination of the Activity Processor and the Resource Allocation Processor, with provision for expressing the two as part of a system, is named Pilot Version Mod 2.

Mod 2 includes the Activity Processor and an attenuated version of the Resource Allocation Processor. Charts for Mod 2 are shown by Figures 4 and 5 in the Appendix.

In Mod 2 all activities have a time duration of only one time unit.

The assignment of one or more time units for the time duration of activities in the model will be a modification of this time control feature. This modification of Mod 2 is called Pilot Version Mod 3. In Mod 3, the time unit used by the Activity Processor is set at 1/8 of an hour. Figures 6 and 7 illustrate Mod 3.

In Mod 2 and Mod 3 of the Pilot Version the only resource demand modifying the model's operation is the student resource. The student(s) must be present in queue for the activity to be made ready. If the number of students necessary for the activity is in queue, that activity will be placed underway.

Since the demand for the student may be either logical or physical, an activity requiring physical presence could not ordinarily be placed underway if some other activity requiring physical presence had engaged the student. The number of logical states, however, would be limited only by the system's capability for providing activities.

In Mod 2 and Mod 3, the difference between the logical and physical state is not made. The system and the student are assumed to have the time and the capability for effecting whatever activities the logical expression of the model demands. As a result of this and the further assumption that there is no resource demand other than the appropriate number of in queue students, the Dormant List of the Activity Processor in Mod 2 and Mod 3 will include only those activities classified under 2a in the Dormant List description given above.

In Mod 2 and Mod 3, therefore, any activity requiring but one student is immediately made ready by the Resource Allocation Processor whenever the logical expression of the simulator releases a student from a terminated activity and distributes the student to a next activity.

Classification of Activities and Resource Allocation Processor Lists

At the end of time unit i, the Activity Processor operation is suspended, and the Resource Allocation Processor is activated.

All the activities listed on the Dormant List, time unit i, are transferred to the:

Interim List, made up of all those activities which may be placed underway in the next time unit, i+1, provided in queue, resource and priority criteria are met.

All the activities on the Active List, time unit i, are reviewed. Those activities which have not been terminated with the end of time unit i are transferred to the:

Continuation List, which is made up of all those activities which will continue underway during time unit i+1.

In Mod 2, since all activities have a time duration of one time unit, no Continuation List of activities is included in the Resource Allocation Processor. All activities underway in time unit i will be deactivated at the end of time unit i. For this reason the Continuation List is deleted from the Mod 2 charts.

Since Mod 3 provides for time durations of one or more time units, the Continuation List is included in its Resource Allocation Processor.

Those activities which have been terminated with the end of time unit i, are transferred to the:

Deactivate List, which includes all those activities which have been terminated at the end of time unit i.

The Resource Allocation Processor releases resources of deactivated activities to inventory and distributes students in the out queue of each activity to the "next" activities by applying the queue distribution rules. If a required next activity is not already on the Interim List (transferred from the Dormant List, time unit i), such an activity is made ready and placed on the:

Make-Ready List, of all those activities required by the distribution of students from deactivated activities, but which have not been previously made ready.

The activities on the Make-Ready List are transferred to the Interim List which has previously received activities from the Dormant List, time unit i, thus completing the Interim List. Then the Resource Allocation Processor analyzes the activities of the Interim List for in queue requirements. Activities on the Interim List which cannot be placed underway by reason of insufficient in queue students, or the necessity for the physical presence of an unavailable student, are placed on the Dormant List, time unit i+1.

Those activities on the Interim List which have the requisite in queue students are placed on the:

Priority List, made up of all those activities, with requisite in queue students, arranged according to the priority rules for placing activities on the Priority List.

The system resource capability is reviewed for the resource demands of each activity on the Priority List, in order of the priority established. All those activities for which the system cannot supply the required resources are placed on the Dormant List, time unit i+1.

Those activities which the system can supply with the required resources are placed on the:

Go List, made up of all those activities which can be placed underway beginning time unit i+1.

In Mod 2 and Mod 3, since all required resources other than students are presumed to be available at any time, activities placed on the Priority List cannot be subsequently diverted to the Dormant List for the reason of insufficient resources. In effect, the entire Priority List is transferred to the Go List.

For this reason, the logical flow of activities from the Priority List to the Dormant List is deleted from the Mod 2 and Mod 3 charts.

The Go List and the Continuation List are combined to form the Active List, time unit i+1.

The Resource Allocation Processor is then deactivated and the Activity Processor is activated for time unit i+1. All the activities on the Active List, time unit i+1, are placed underway. The cycle of resource allocation analysis based on the simulation of time unit i is complete.

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APPENDIX

Flow charts

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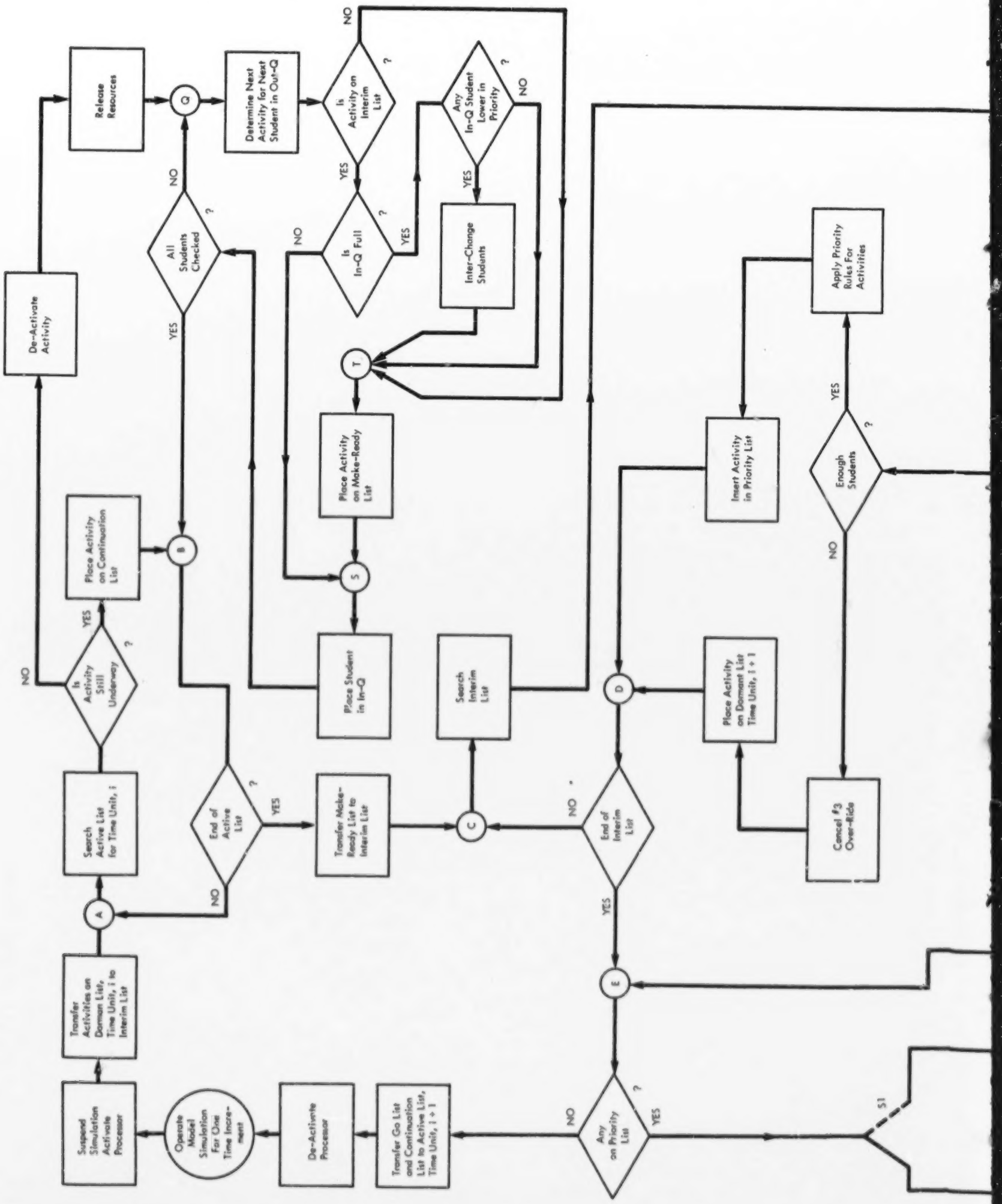

FIGURE 1. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION

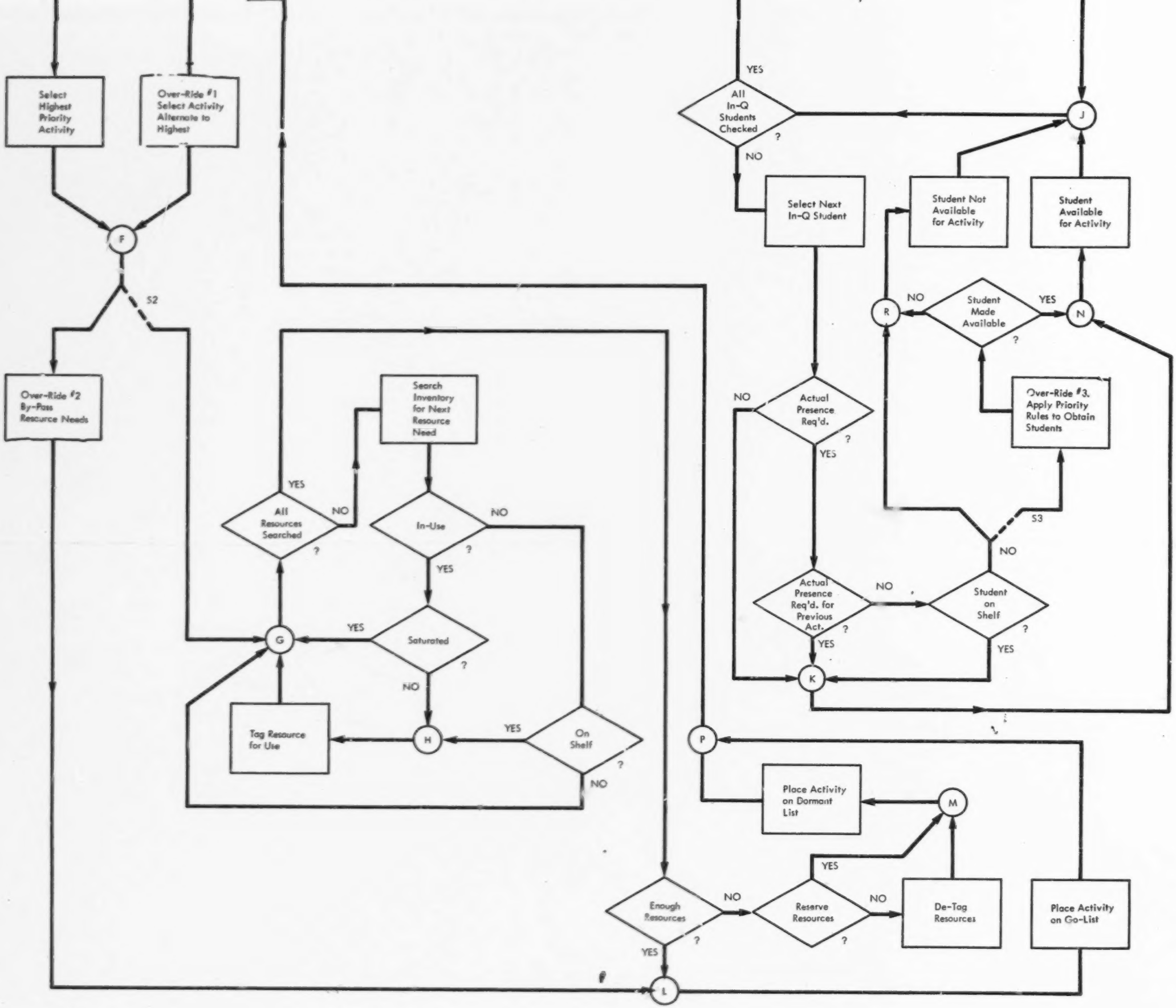
Select Highest Priority Activity
Over-Ride #1 Select Activity Alternate to Highest
F
S2
Over-Ride #2 By-Pass Resource Needs
Search Inventory for Next Resource Need
All Resources Searched
YES
NO
In-Use
YES
NO
Saturated
YES
G
NO
Tag Resource for Use
H
On Shelf
YES
NO
All In-Q Students Checked
YES
NO
Select Next In-Q Student
Student Not Available for Activity
Student Available for Activity
J
R
NO
Student Made Available
YES
N
Over-Ride #3. Apply Priority Rules to Obtain Students
S3
NO
Actual Presence Req'd.
NO
YES
Actual Presence Req'd. for Previous Act.
NO
Student on Shelf
YES
K
P
Place Activity on Dormant List
M
Enough Resources
NO
YES
Reserve Resources
NO
YES
De-Tag Resources
Place Activity on Go-List
L

FIGURE 2. RESOURCE ALLOCATION PROCESSOR ACTIVITY LISTS

STEP	DESCRIPTION
(1.)	De-Activate Activity Processor; activate Resource Allocation Processor.
(2.)	Transfer activities on Dormant List, time unit, i, to Interim List.
(3.)	Search Active List; Transfer activities not yet terminated to Continuation List; transfer activities terminated to De-Activate List.
(4.)	Prepare Make-Ready List from Q-distribution of activities on De-activate List.
(5.)	Transfer activities on Make-Ready List to Interim List.
(6.)	Search Interim List; transfer activities with required in-Q students to Priority List under priority criteria; transfer activities without required in-Q students to Dormant List, time unit, i + 1.
(7.)	Search Priority List; transfer activities supplied required resources to Go List; transfer activities without required resources to Dormant List, time unit, i + 1.
(8.)	Transfer activities on Go List and Continuation List to Active List, time unit, i + 1.
(9.)	De-activate Resource Allocation Processor; activate Activity Processor.

NAME OF LIST	NUMBER OF ACTIVITIES ON LIST
Dormant List, i	L1
Active List, i	L2
De-Activate List	L3
Continuation List	L4
Make-Ready List	L5
Interim List	L6
Priority List	L7
Go List	L8
Active List, i + 1	L9
Dormant List, i + 1	L10

L9 + L10 = L1 + L2 - L3 + L5
L2 = L3 + L4
L6 = L1 + L5
L9 = L4 + L8
L10 = L6 - L8

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FIGURE 2. RESOURCE ALLOCATION PROCESSOR
ACTIVITY LISTS

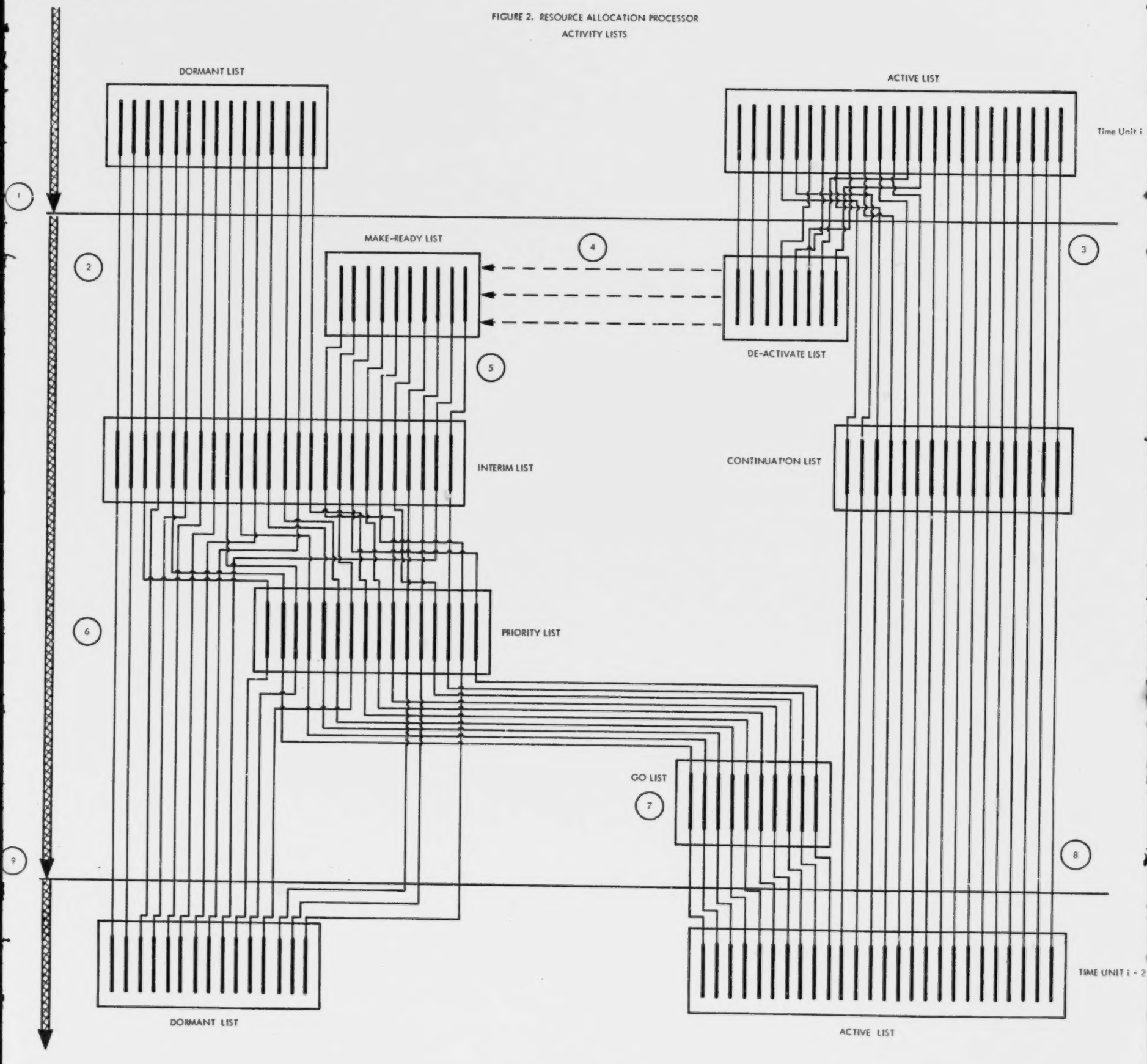

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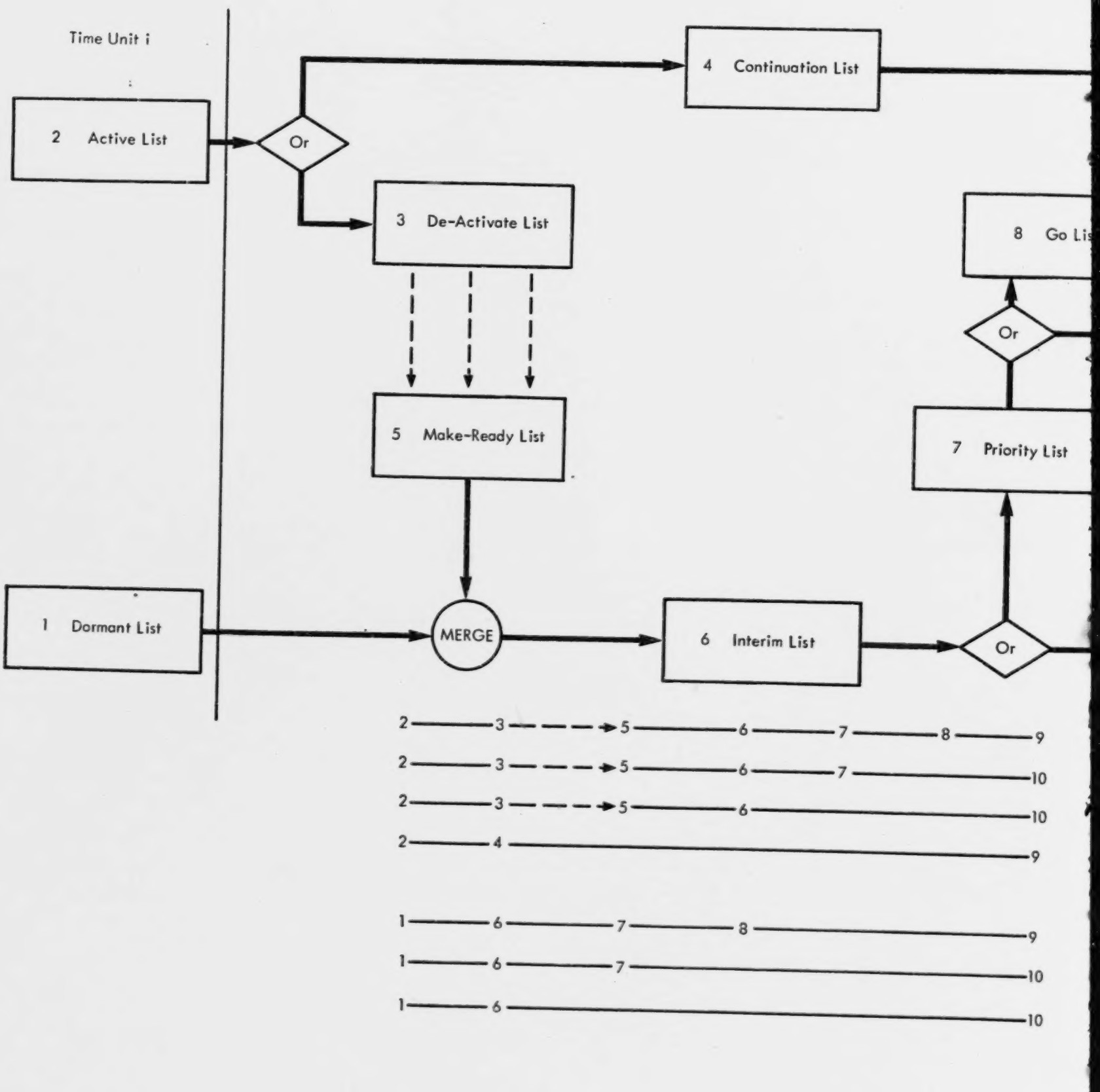
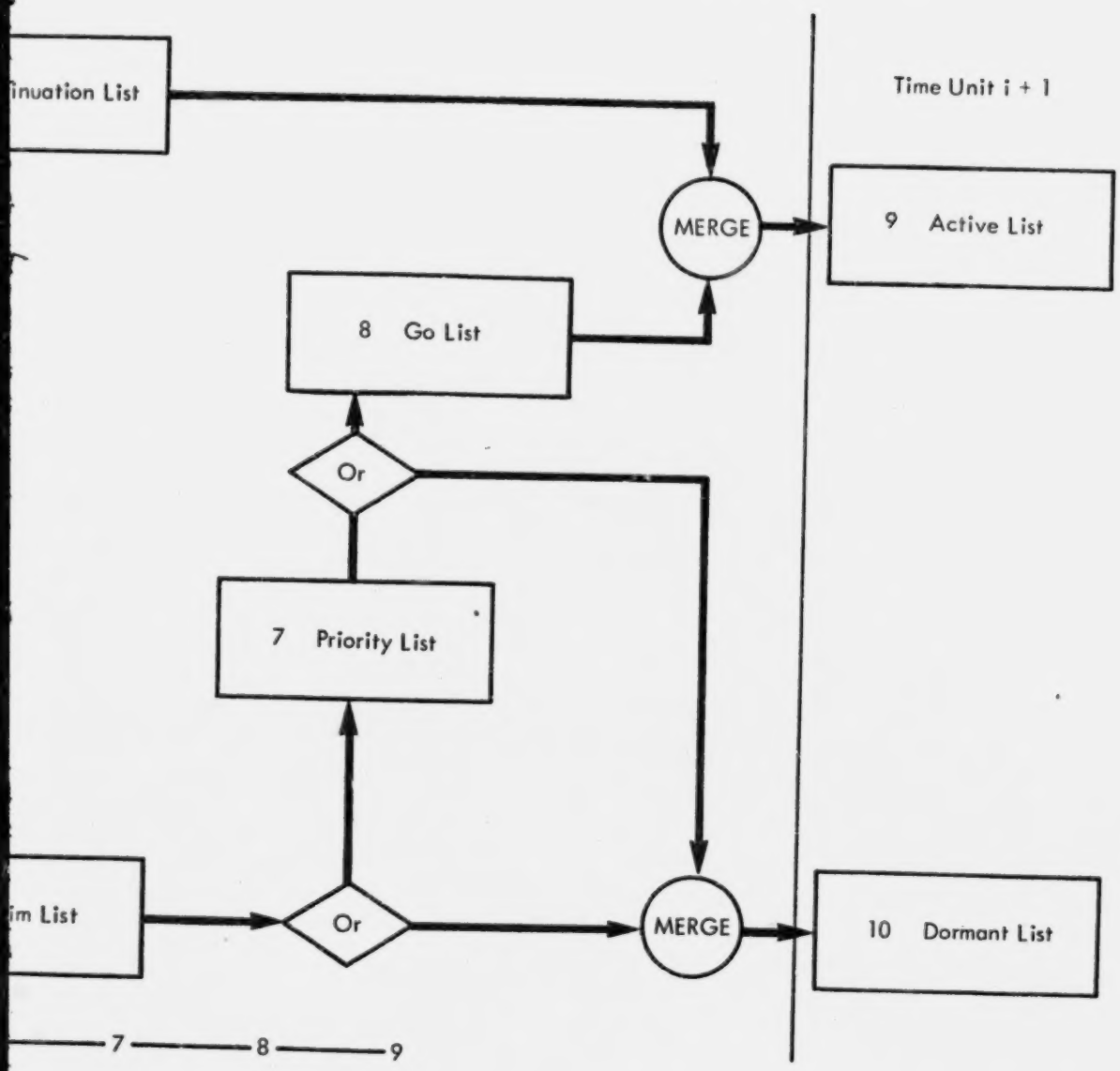
FIGURE 3. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION
LOGICAL FLOW OF ACTIVITIES


Time Unit i
2 Active List
Or
4 Continuation List
3 De-Activate List
5 Make-Ready List
1 Dormant List
MERGE
6 Interim List
Or
7 Priority List
8 Go Lis
Or
2 — 3 - - - → 5 — 6 — 7 — 8 — 9
2 — 3 - - - → 5 — 6 — 7 — 10
2 — 3 - - - → 5 — 6 — 10
2 — 4 — 9
1 — 6 — 7 — 8 — 9
1 — 6 — 7 — 10
1 — 6 — 10

ALLOCATION PROCESSOR
PILOT VERSION
L FLOW OF ACTIVITIES



7 — 8 — 9
7 — 10
10
9

9
10
10

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FIGURE 4. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2

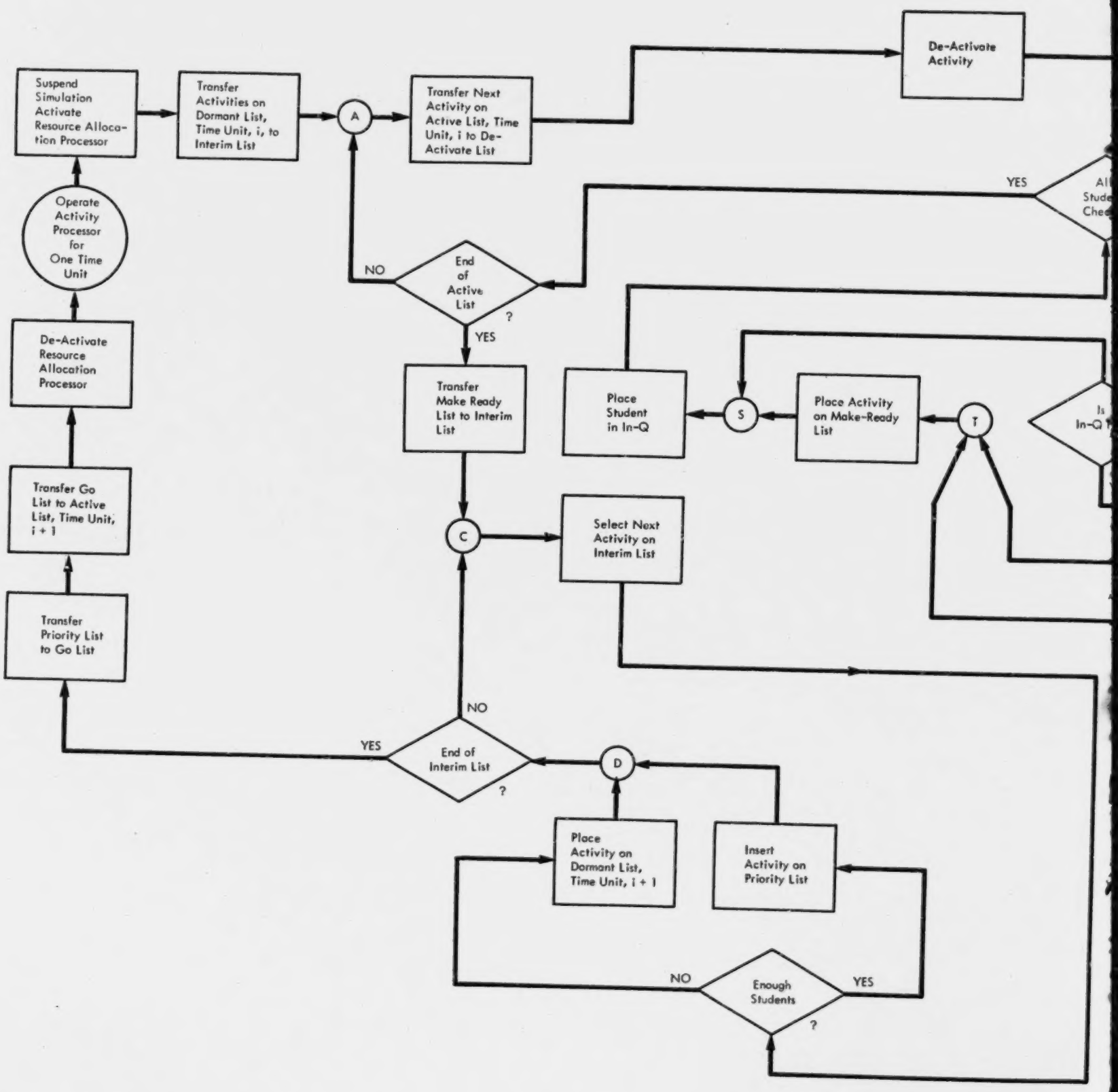
Suspend Simulation Activate Resource Allocation Processor
Transfer Activities on Dormant List, Time Unit, i, to Interim List
A
Transfer Next Activity on Active List, Time Unit, i to De-Activate List
De-Activate Activity
YES
NO
End of Active List ?
YES
Operate Activity Processor for One Time Unit
De-Activate Resource Allocation Processor
Transfer Make Ready List to Interim List
Place Student in In-Q
S
Place Activity on Make-Ready List
T
Transfer Go List to Active List, Time Unit, i + 1
C
Select Next Activity on Interim List
Transfer Priority List to Go List
NO
YES
End of Interim List ?
D
Place Activity on Dormant List, Time Unit, i + 1
Insert Activity on Priority List
NO
Enough Students ?
YES

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FIGURE 4. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2

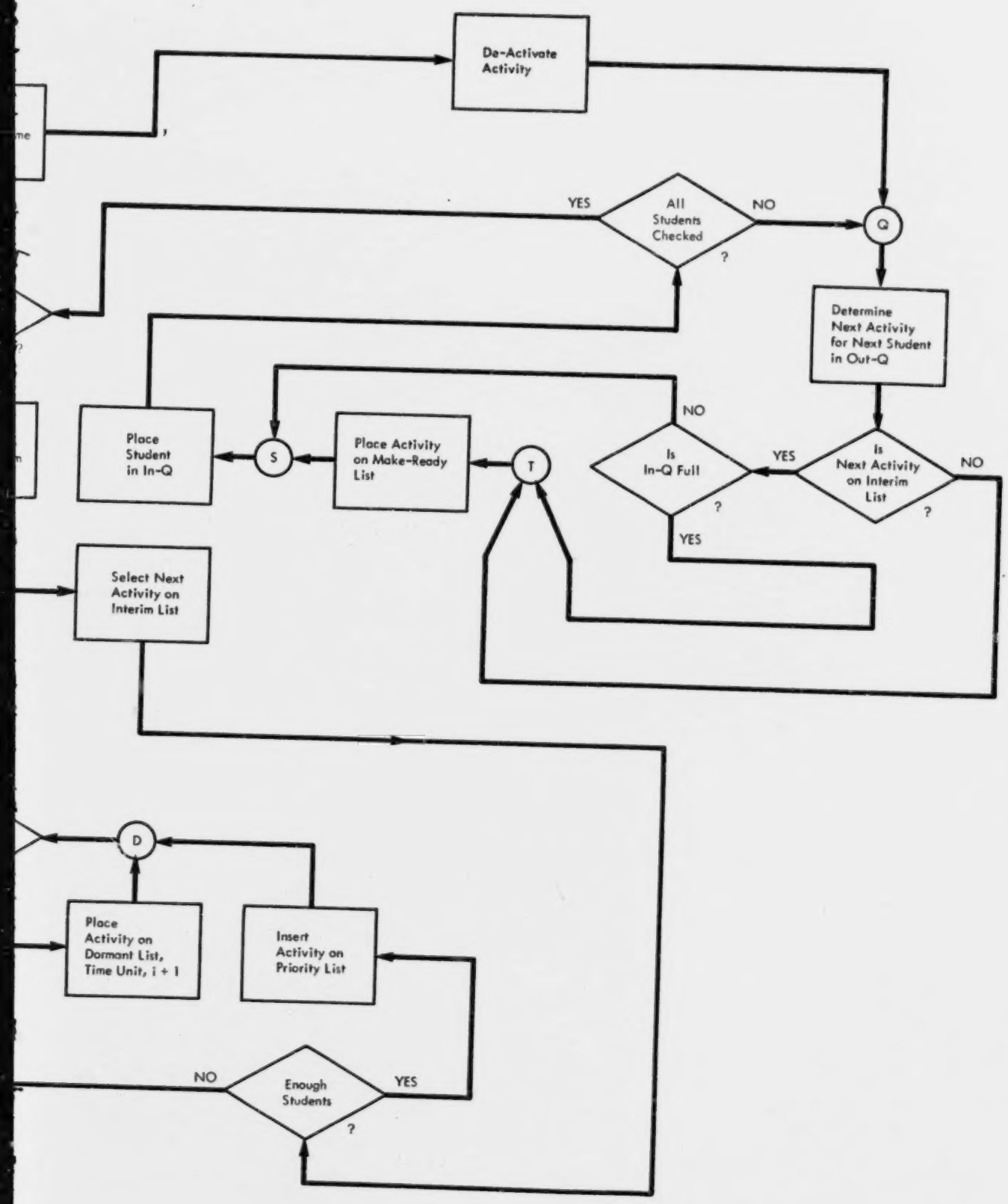

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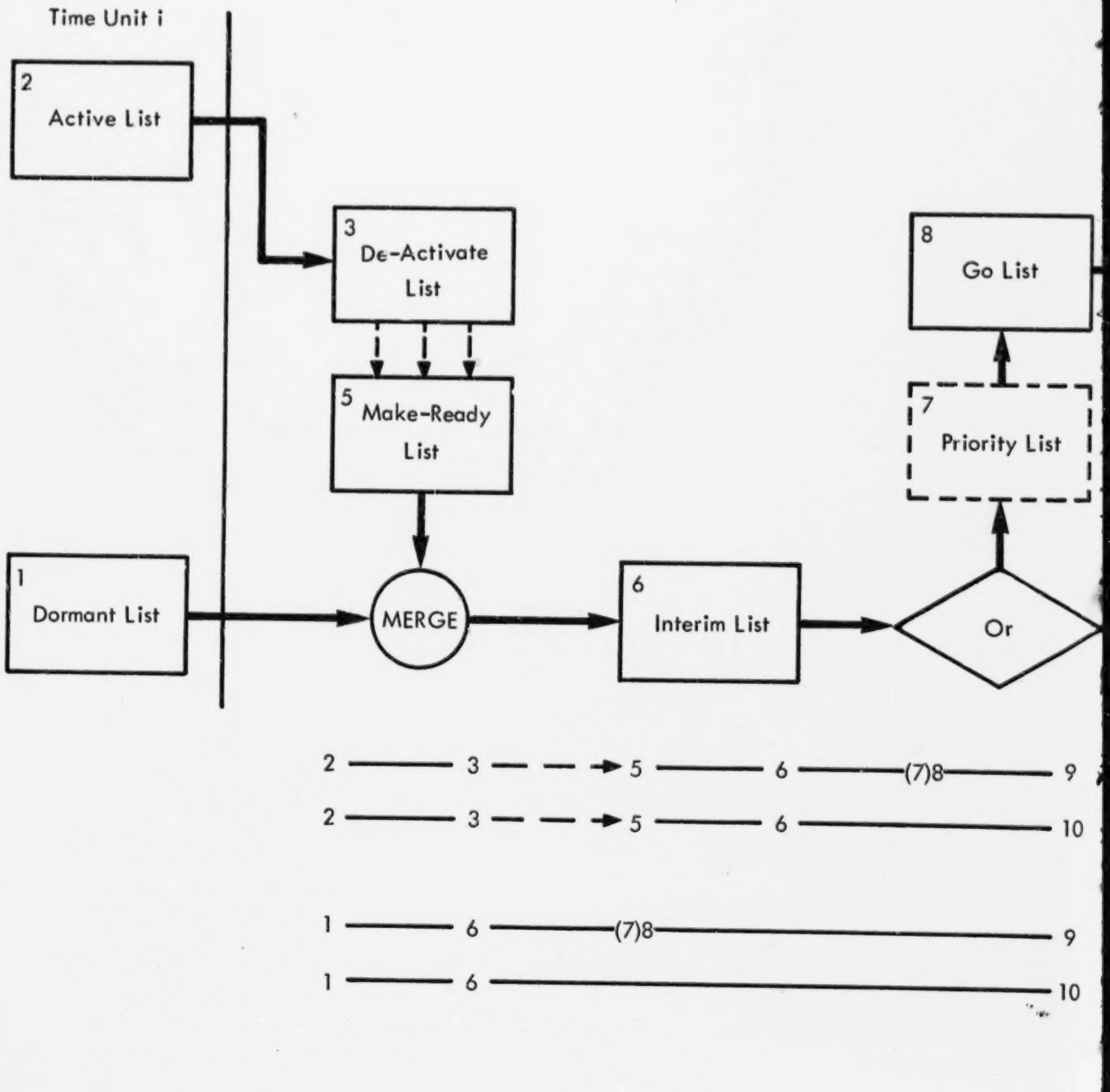
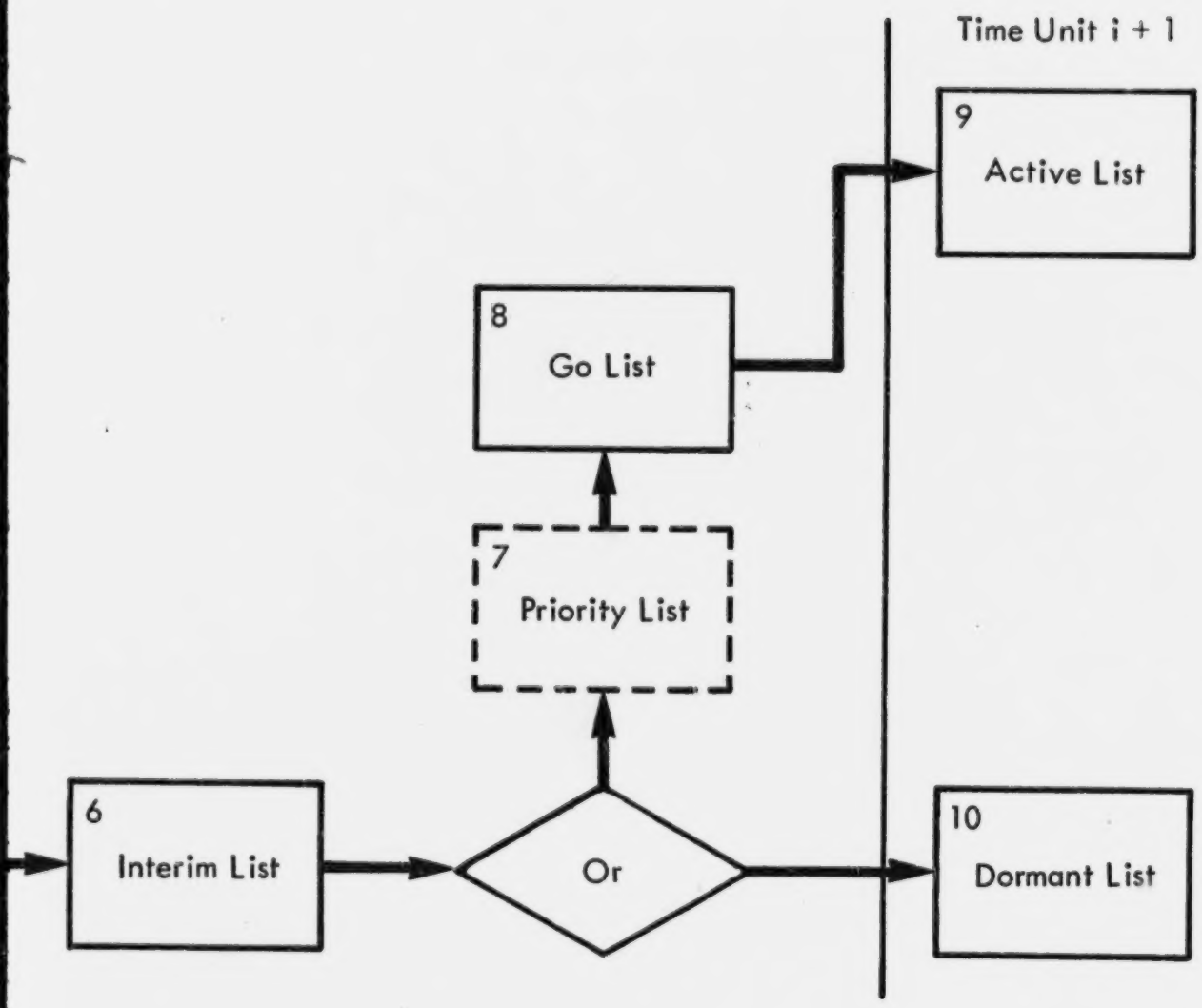
FIGURE 5. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2
LOGICAL FLOW OF ACTIVITIES



RCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2
GICAL FLOW OF ACTIVITIES



5 — 6 — (7)8 — 9

5 — 6 — 10

(7)8 — 9

10

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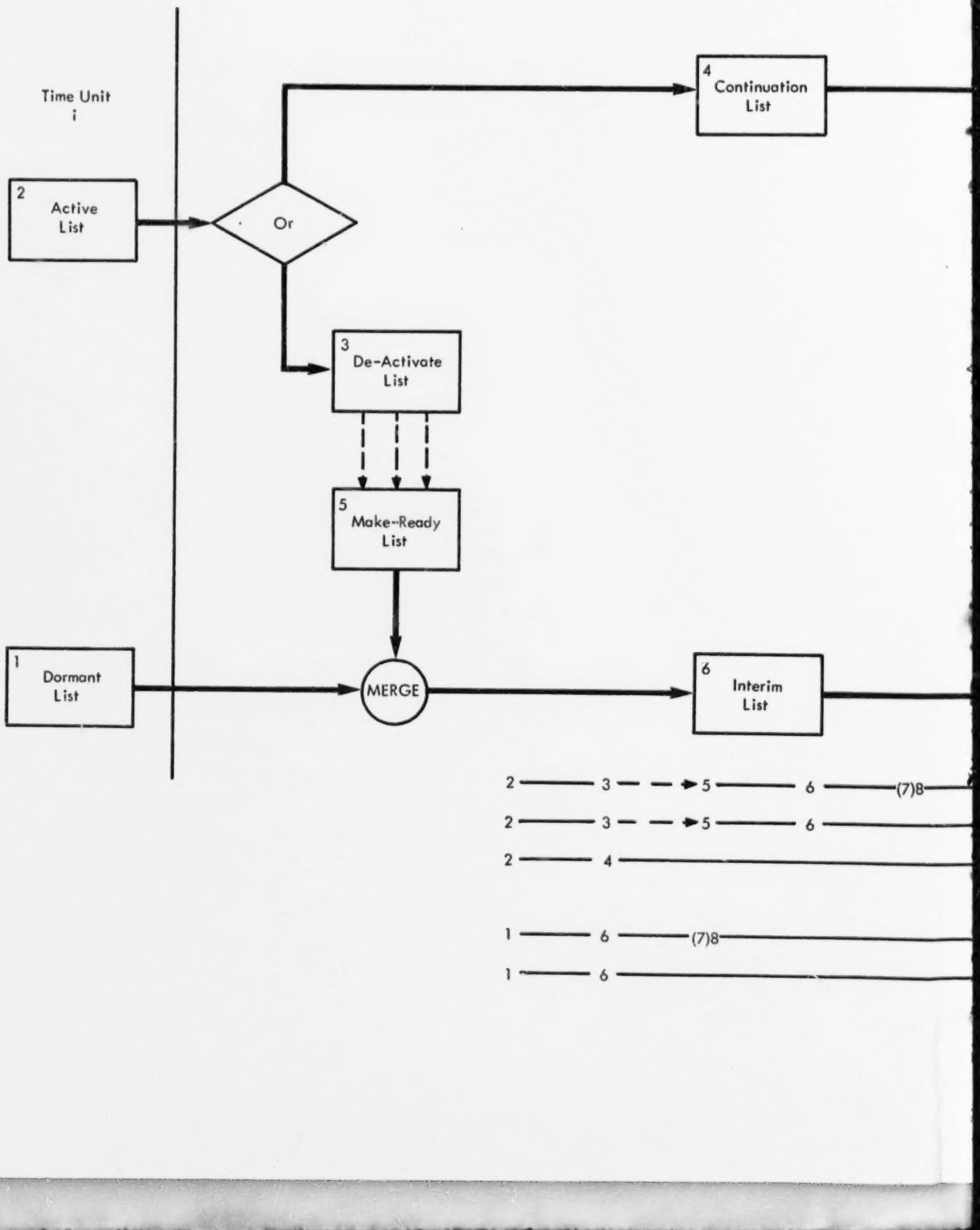
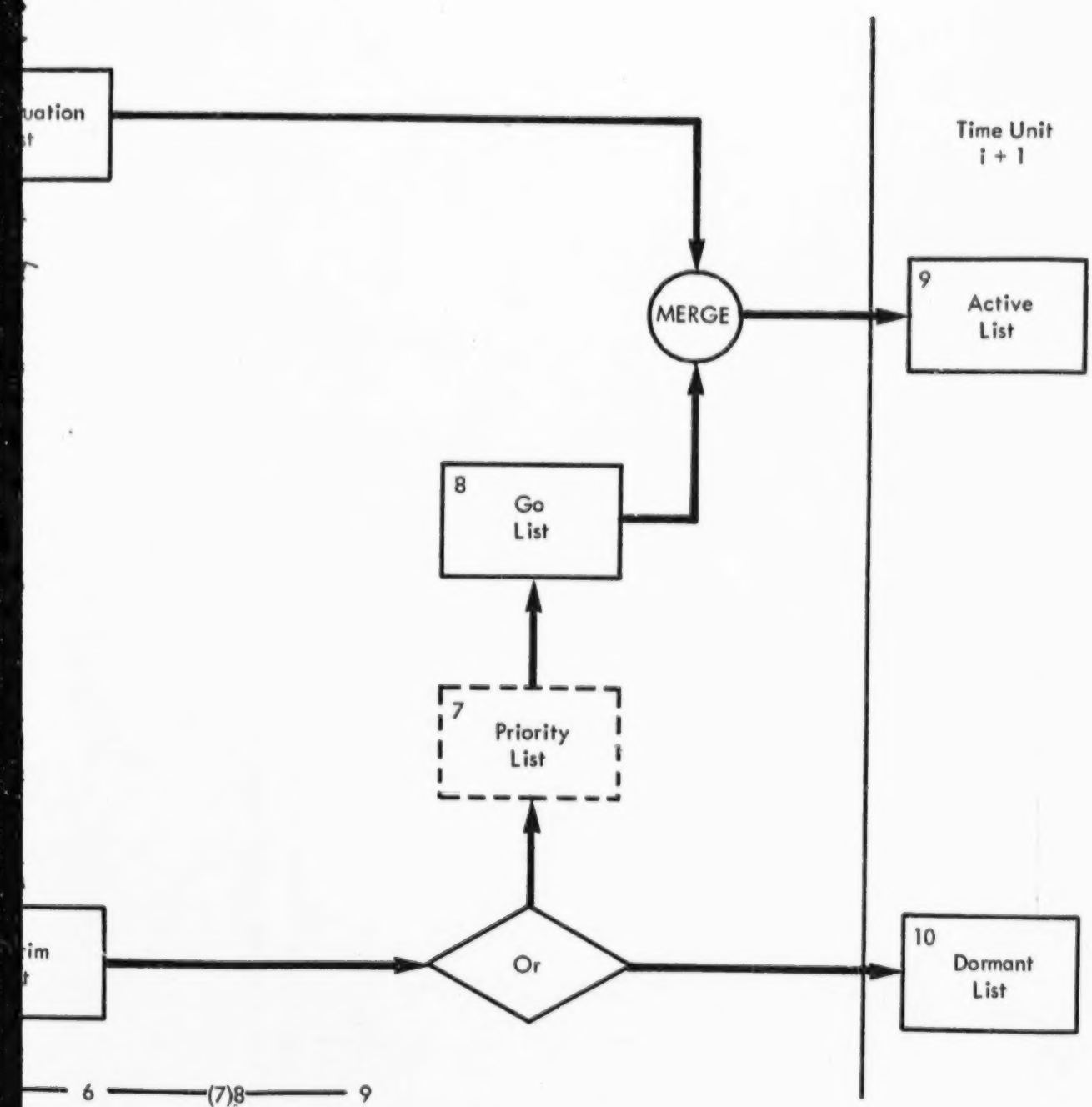
FIGURE 6. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 3
LOGICAL FLOW OF ACTIVITIES



LOCATION PROCESSOR
VERSION MOD 3
FLOW OF ACTIVITIES



6 —— (7)8 —— 9

6 —— 10

9

9

10

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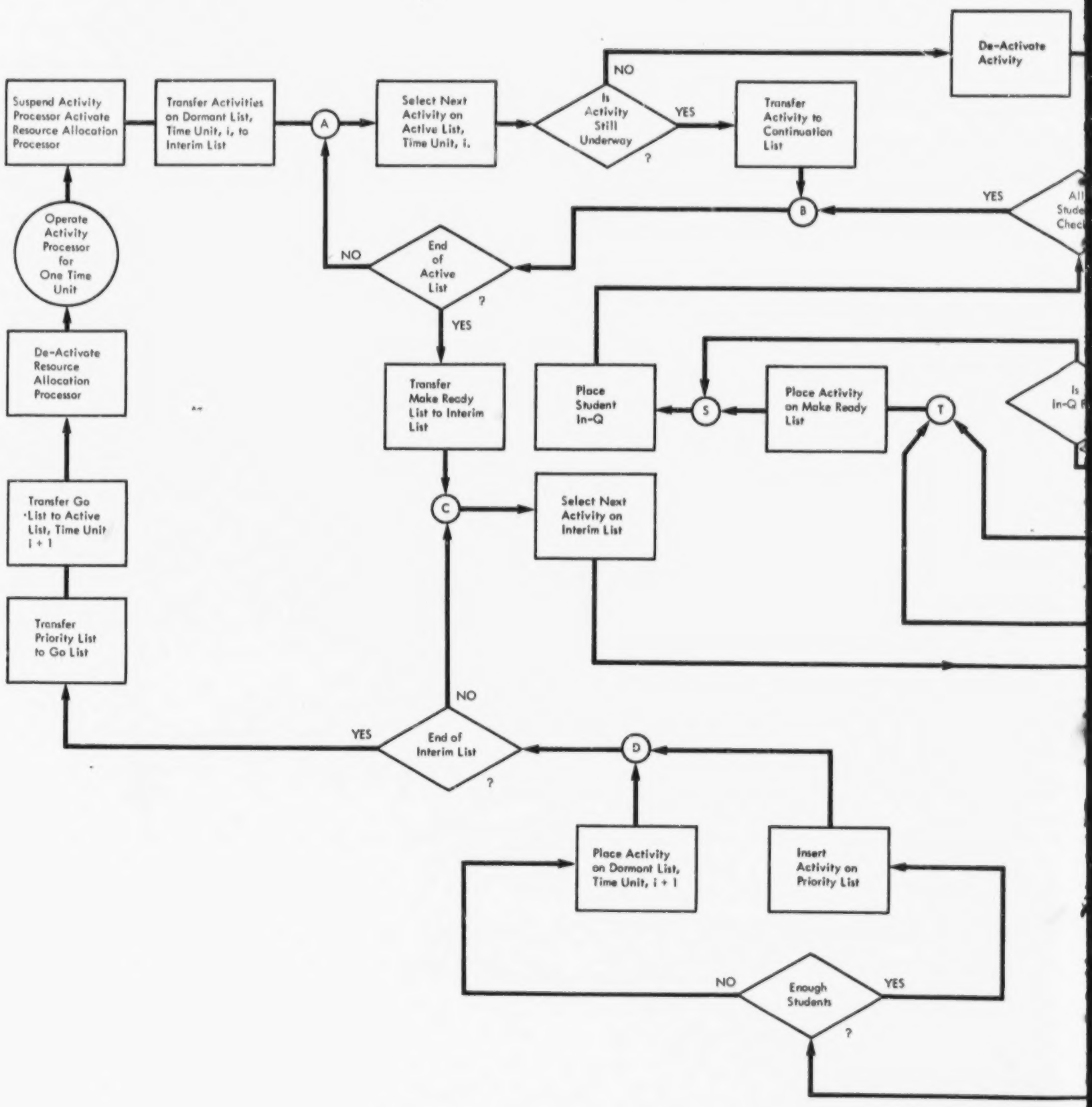
FIGURE 7. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 3



CE ALLOCATION PROCESSOR
ILOT VERSION MOD 3